Air, Air is Everywhere

Action For a Cleaner Tomorrow

SC DHEC

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Composition of Air
(Air, Air is Everywhere Lesson pg 3)

- Air is a fluid that fills corners, holes, nooks, and crannies.
- The air we breathe is a mixture of gases composed primarily of 78% Nitrogen and 21% Oxygen.
- We can not see air unless it contains solid particles or liquid particles know at **particulate matter**. It is more commonly referred to as fog, smog, or smoke.

Smog in a Jar

Question

- How would you define Air Pollution?
  - Anything that impacts the quality of life to humans, animals, and the environment.
- What do you think contributes most to Air Pollution?
  - Impact to air quality comes from two sources:
    - Naturally occurring air pollution
    - Man made air pollution

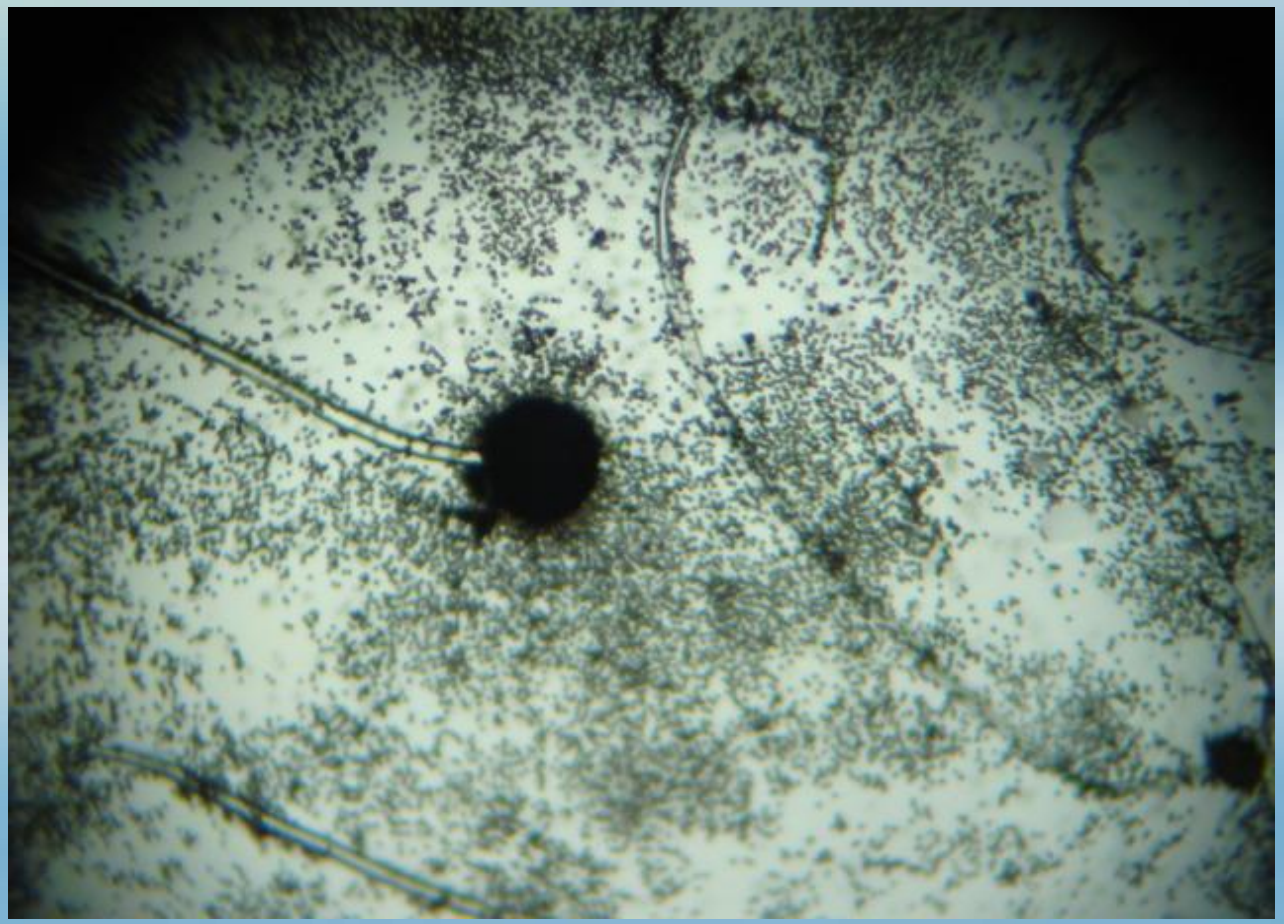
What are some examples of naturally occurring air pollution?

Volcano

Forest Fire

Lightning

Pollen and Spores



Oil Seep

Pine Trees

Termites

What are some examples of man made air pollution?

Stack Emissions

Mobile Emissions

Open Burning

Motor Vehicle Fueling

Campfire

What are VOCs and HAPs?

- VOCs are Volatile Organic Compounds
- Volatile organic compounds (VOCs) are emitted as gases from certain solids or liquids.
- VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects.
- Organic chemicals are widely used as ingredients in household products.
- Examples include: paints and lacquers, paint strippers, cleaning supplies, and permanent markers.
- VOCs are also naturally occurring. They are released from pine trees and termites.

HAPs

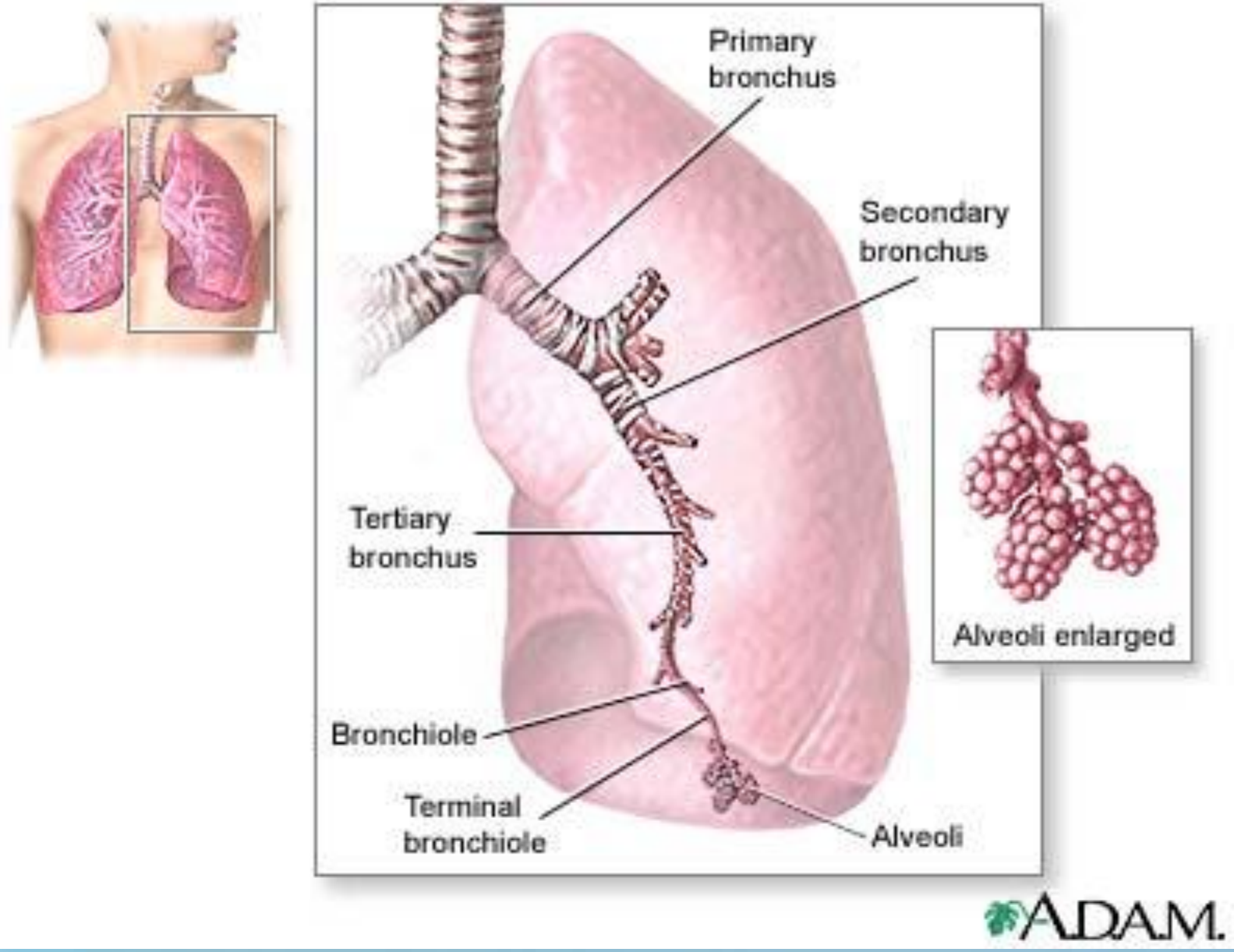
- HAPs are hazardous air pollutants.
- Hazardous air pollutants, also known as toxic air pollutants or air toxics, are those pollutants that cause or may cause cancer or other serious health effects, and adversely effect the environment.
- Most air toxics originate from human-made sources, including mobile sources (e.g., cars, trucks, buses) and stationary sources (e.g., factories, refineries, power plants), as well as indoor sources (e.g., building materials and activities such as cleaning).

How Air Quality Impacts Human Health

What part of the body do you think these types of air pollution examples would impact the most?

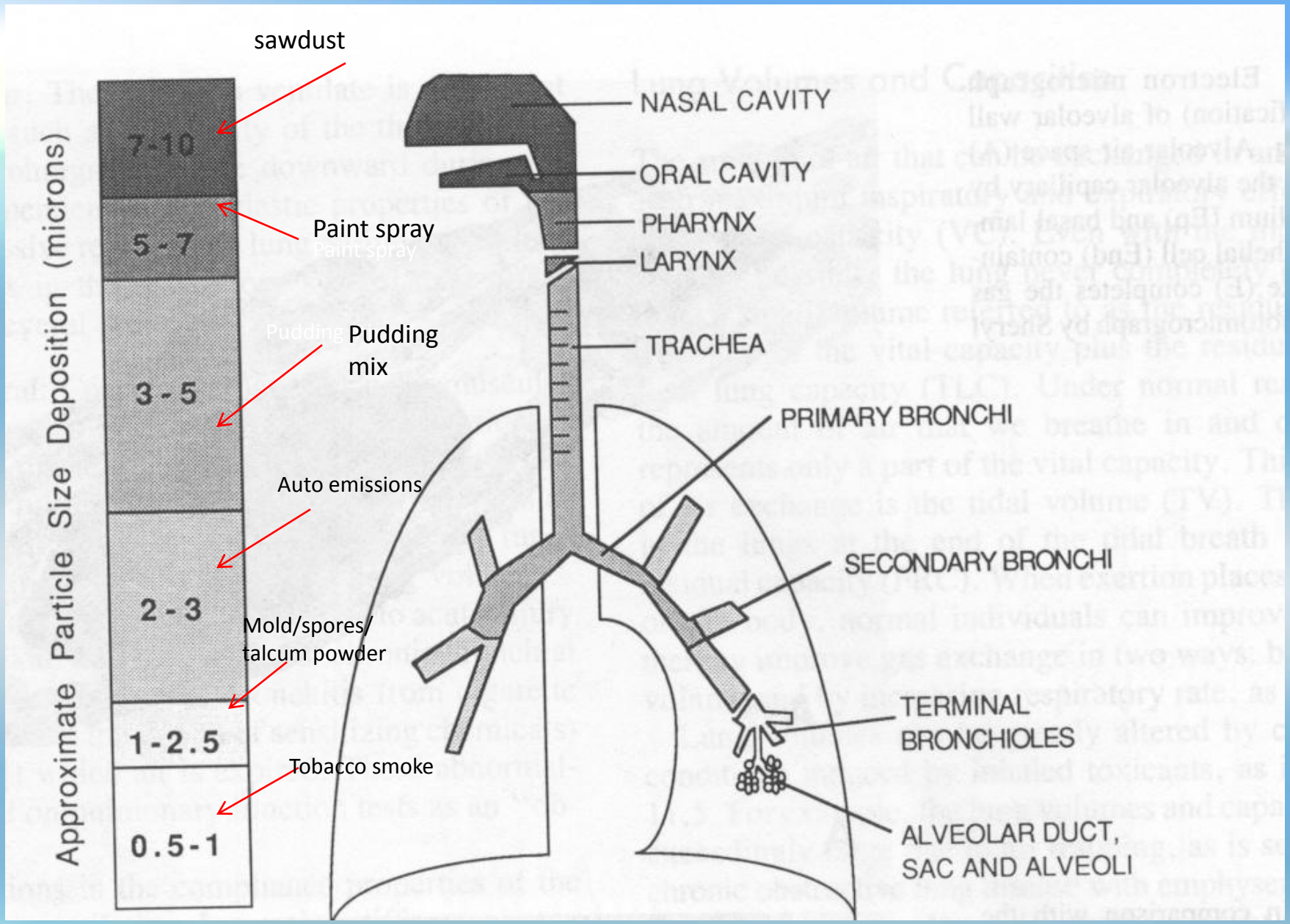
Routes of Entry

- There are four commons routes of entry into the body. Can you name them??
- Ingestion
- Absorption
- Injection
- Inhalation
- Which is the easiest route of entry?


Primary bronchus
Secondary bronchus
Tertiary bronchus
Bronchiole
Terminal bronchiole
Alveoli
Alveoli enlarged
A.D.A.M.

Particle Size Characteristics

- General term for all particles suspended in the air in the form of solid and liquid droplets
- Particulate Matter (PM) can be large enough to see such as smoke or soot
- PM10 - Particles that are 10 micrometers or smaller
  - 1/7 the size of a human hair
- PM2.5 - Particles that are 2.5 micrometers or smaller
  - 1/30 the size of a human hair


sawdust
Paint spray
Pudding mix
Auto emissions
Mold/spores/ talcum powder
Tobacco smoke
Approximate Particle Size Deposition (microns)
7-10
5-7
3-5
2-3
1-2.5
0.5-1
NASAL CAVITY
ORAL CAVITY
PHARYNX
LARYNX
TRACHEA
PRIMARY BRONCHI
SECONDARY BRONCHI
TERMINAL BRONCHIOLES
ALVEOLAR DUCT, SAC AND ALVEOLI

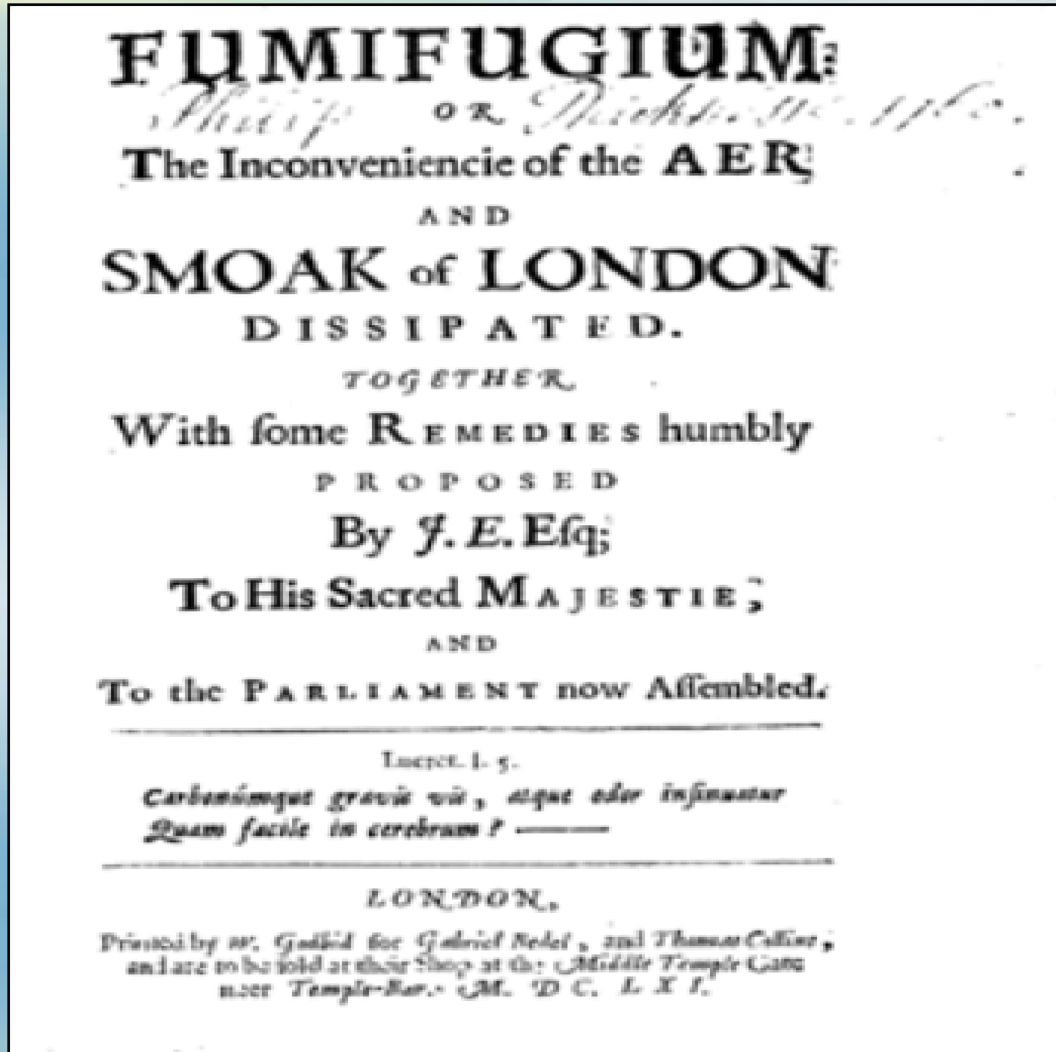
Clearance of Particles

- Nasal clearance – physical removal and to GI
- Traecheobronchial clearance
  - Mucociliary escalator
- Pulmonary clearance
  - Mucociliary escalator
  - Phagocytosis and movement to mucociliary escalator
  - Phagocytosis and movement to lymphatic system
  - Dissolved and removed by lymphatic system or absorbed
  - Penetration of the epithelium membranes

Historical Perspective

- When do you think the first known record of someone complaining about air pollution occurred?
  - In 1661, John Evelyn lobbied to King Charles, II against a few trades brewers, dyers, soap and salt boilers, lime-burners, and blacksmiths and due to the smell he included butchers and candle makers. He proposed that these industries relocate five or six miles outside the city.

DENIED…..King Charles, II refused his request



FUMIFUGIUM:

OR

The Inconvenience of the AER

AND

SMOAK of LONDON

DISSIPATED.

TOGETHER

With some REMEDIES humbly

PROPOSED

By *J. E.* Esq;

To His Sacred MAJESTIE;

AND

To the PARLIAMENT now Assembled.

Lucret. l. 5.

Carbonúmque gravis vis, atque odor insinuatur
Quam facilè in cerebrum? ———

LONDON,

Printed by *W. Godbid* for *Gabriel Bedel*, and *Thomas Collins*, and are to be sold at their Shop at the *Middle Temple* Gate neer *Temple-Bar*. *M. DC. LXI.*

Question???

- Why do you think there was a need for the formation of air regulations??
  - Impact to health and the environment
    - What year was the Environmental Protection Agency formed?
      - December 2, 1970 After which time many regulations pertaining to air and water were created for the protection of environmental resources and human health.

Clean Air Act

EPA initially enacted in 1963, but national air pollution control program is based on the 1970 version of the law. The Clean Air Act was revised again in 1990.

Clean Air Act

- Some common air pollutants are found all over the United States. These pollutants can injure health, harm the environment, and cause property damage.
  - They are called **Criteria Air Pollutants.**

Criteria Air Pollutants

- Categorized as Primary and Secondary.
- Primary relate to protection of health.
- Secondary intended to protect environment and property damage.
- There are six criteria pollutants:
  - Ozone
  - Carbon Monoxide
  - Nitrogen Dioxide
  - Sulfur Dioxide
  - Particulate Matter (PM)
  - Lead

Ozone- O_3

- Ozone is the reaction of Volatile Organic Compounds (VOC), Nitrogen, and the presence of sunlight or heat.
- $VOC + NO_2 \xrightarrow{heat} O_3$
- Sources of Ozone include:
- vehicle emissions
- factories
- farm and lawn equipment
- landfills

Ozone (cont.)

- Ozone can be good or bad depending on its location.
  - Ozone in the Stratosphere protects the environment from the harmful rays of the sun.
  - Ground level ozone can be harmful to humans and the environment.

Particulate Matter- PM

- Solid matter or liquid droplets from smoke, dust, flyash, and condensing vapors that can be suspended in the air for long periods of time.
- Sources include:
- Industrial processes, automobiles, wood smoke, dust from unpaved roads, construction and agricultural sites.

Carbon Monoxide, Nitrogen Dioxide, Sulfur Dioxide, and Lead

- These are the other four Criteria Air Pollutants.
- They are emitted by:
  - burning fuels in utilities, industrial boilers, cars, and trucks.
- Each pollutant has its own distinctive physical characteristics with colors, odors, etc.

Greenhouse Gases

- Water Vapor
- Carbon Dioxide
- Methane
- Nitrous Oxide
- Ozone

- Two areas of concern that contribute to poor air quality and have an immediate impact on the respiratory system are:
- **OPEN BURNING** of Household Garbage
- **MOBILE SOURCES** such at automobile exhaust

Give Burn Barrels the Boot (pg 13)

Open Burning

- Household garbage tends to burn at a relatively low temperature with poor combustion. As a result, it generates many different pollutants including toxic chemicals, and particles that can affect the respiratory system.
- The motivations for households burning their garbage may include convenience, habit, or to avoid paying for proper disposal at a landfill.
- Emissions from backyard burning of residential solid waste are released at ground level resulting in decreased dilution by dispersion.

Mobile Sources

- "Mobile sources" is a term used to describe a wide variety of vehicles, engines, and equipment that generate air pollution and that move, or can be moved, from place to place.
- Emissions from mobile sources include: Carbon Monoxide, Hydrocarbons, Nitrogen Oxides, and Particulate Matter.
- Nationwide, mobile sources represent the largest contributor to air toxics.
- Air toxics are pollutants known or suspected to cause cancer or other serious health or environmental effects.

Mobile Source Emissions

- Some ways to decrease emissions include:
  - Anti-idling
  - Car pooling
  - Combining errands
  - Don’t fuel between 9am-6pm.
  - Mow grass after 6pm


Turn off
your engine
Clean Air Zone
NO-IDLE
ZONE
It All Adds Up To Cleaner Air

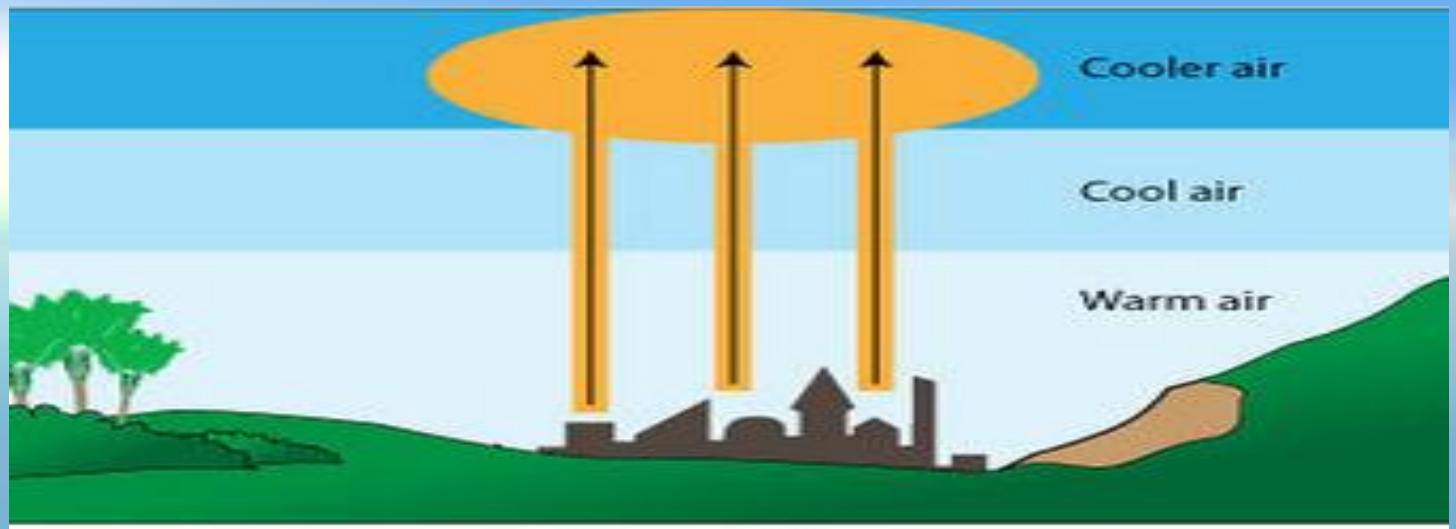

NO-IDLE
ZONE
NO IDLING
ASTHMA
FREE
SCHOOL
ZONE


CLEAN
AIR
COUNTS
Make A
Visible
Difference
Save fuel and air
Please don't idle

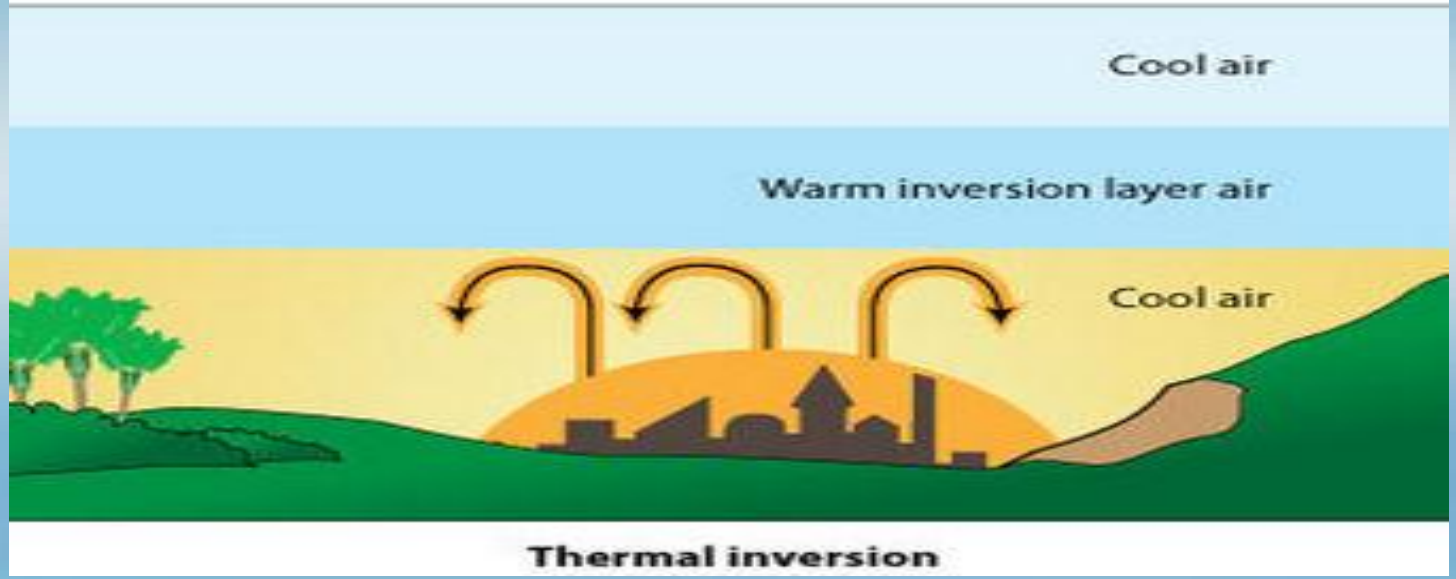
Weather And Its Impact On Air Quality

Temperature Inversion (pg 21)

- What do you think a temperature inversion is?
  - Condition in which the temperature of the atmosphere increases with altitude in contrast to the normal decrease with altitude
- Temperature inversions can:
  - Keep odors close to the ground
  - Cause smoke to travel close to the ground

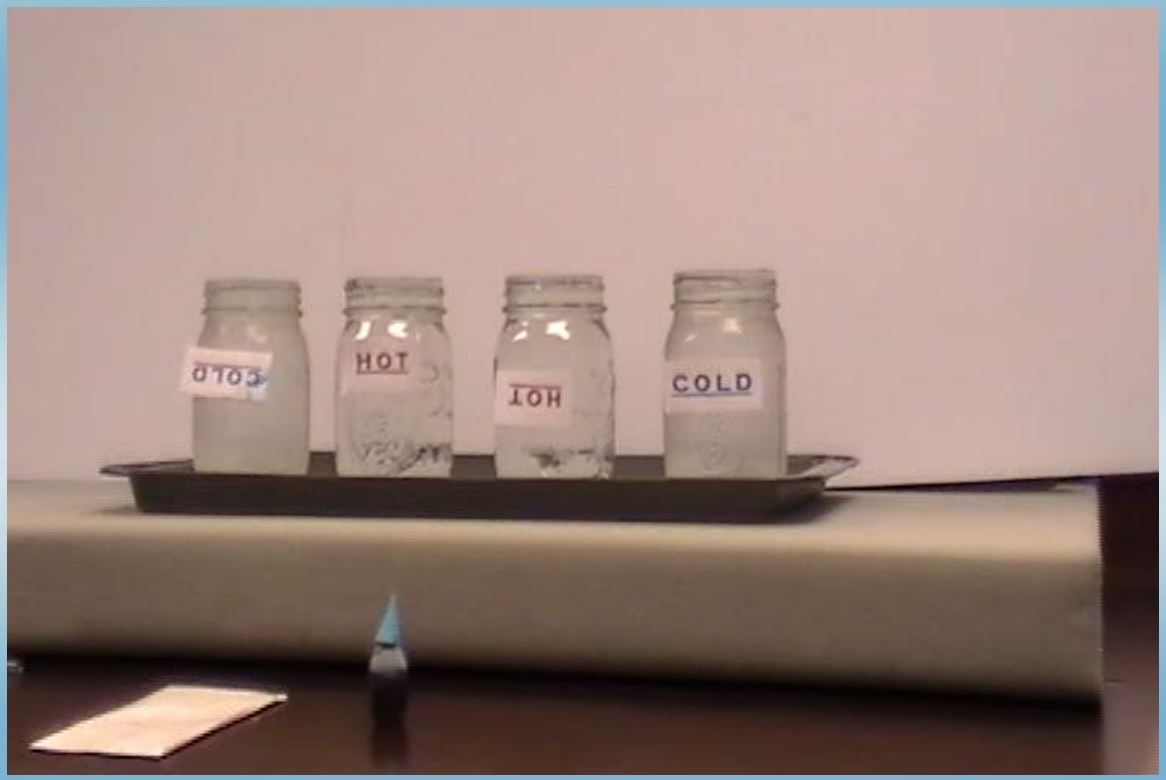


Normal pattern



Thermal inversion

Temperature Inversion



Temperature Inversions-Donora, PA

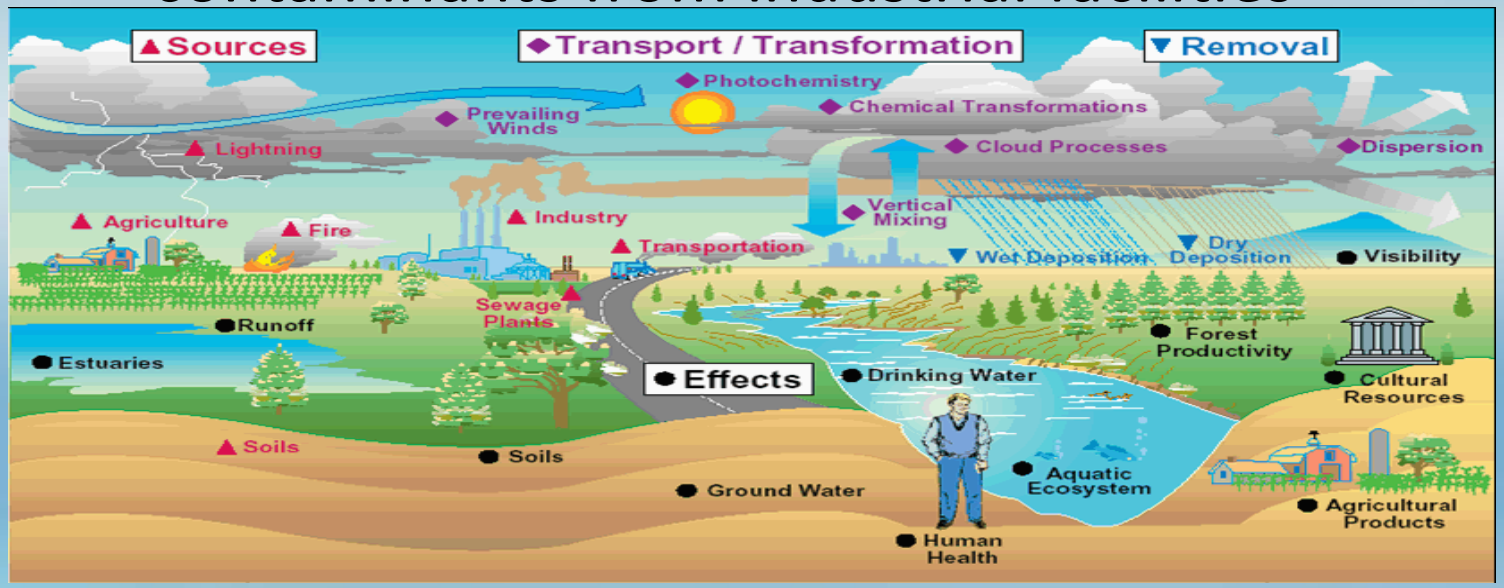
Donora, PA

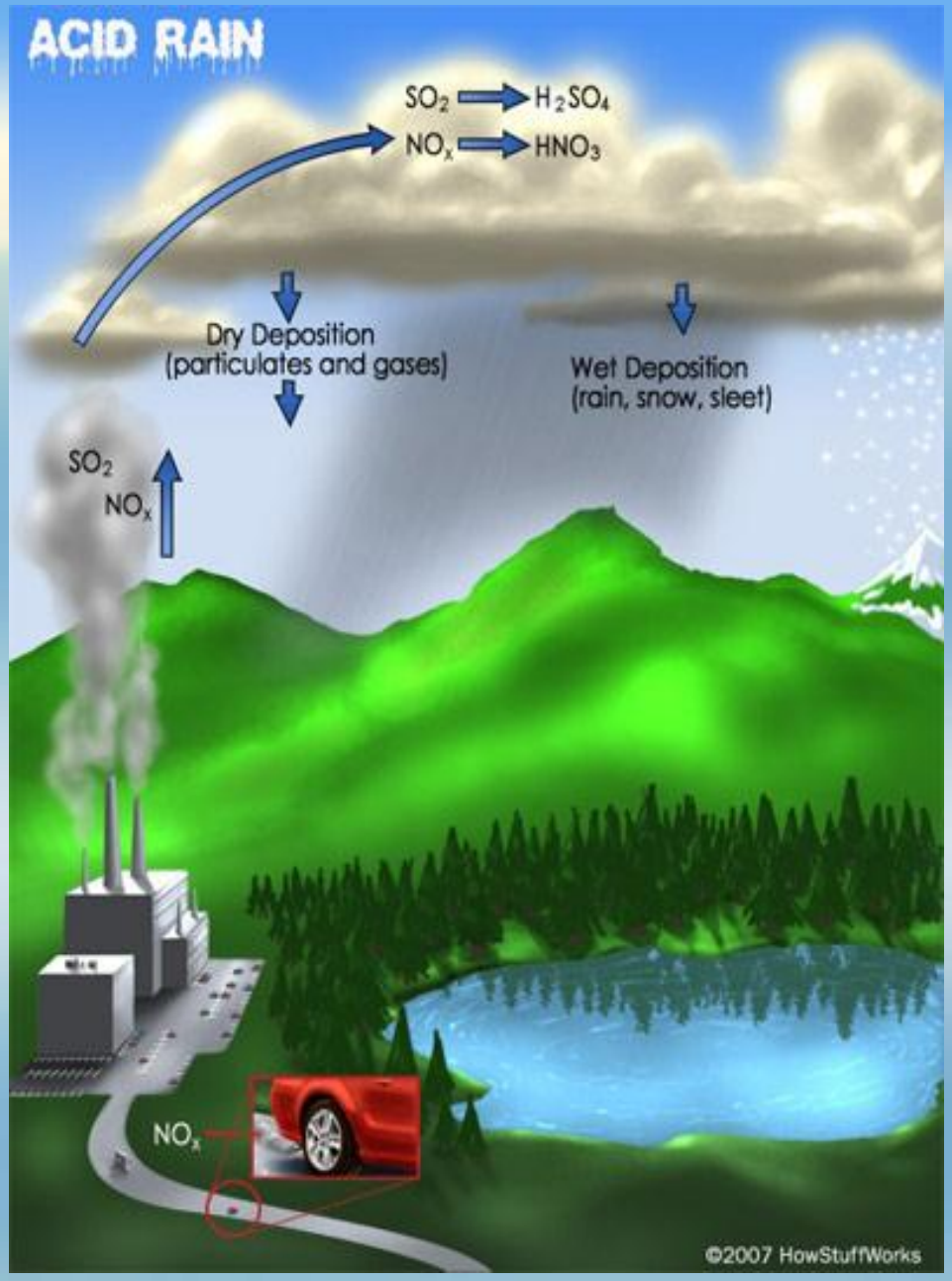
- Streetlights were on at Noon on October 29, 1948 when a heavy smog settled on Donora, PA from October 30 - 31, 1948 known as the "Donora Death Fog“
- Temperature inversion kept the fog down for 5 days.
- 20 Excess Deaths
- Local doctors contended one more night of smog and the death toll would have been 1000 vs. 20
- Considered to be the worst air pollution disaster in America History
- 7000 Acute Illnesses or Hospitalization
  - 50% of total population was impacted

PHS engineer George Clayton prepares an air quality device on a hill overlooking Donora.

Wind

- Wind aids in the dispersion of:
  - acid rain
  - smoke from forest fires
  - ash from volcanoes
  - contaminants from industrial facilities




ACID RAIN
$SO_2 \rightarrow H_2SO_4$
$NO_x \rightarrow HNO_3$
Dry Deposition
(particulates and gases)
Wet Deposition
(rain, snow, sleet)
SO_2
NO_x
NO_x
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Smoke

Questions???


Wizard of Id
by parker and hart
DOES IT SEEM WARM IN HERE TO YOU?
I SMELL SMOKE!
I WARNED YOU, PAL!
KERSPLASH
KEEP THOSE EMISSIONS UNDER CONTROL!
WOW! THE NEW HEAD OF THE E.P.A. DOESN'T MESS AROUND!
PARKER